Approved For Release 2008/05/29 : CIA-RDP90B00170R000200280024-7

Lockheed AIRCRAFT CORPORATION
CALIFORNIA DIVISION

A HIGH ALTITUDE RECONNAISSANCE AIRCRAFT

Description of Type

Outline of Major Problems

Program for Development

Prepared by:

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Date: December 9, 1954

Classification:

Approved For Release 2008/05/29 : CIA-RDP90B00170R000200280024-7

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FORM 57057A-1

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INTRODUCTION

This report presents data on a program for development of a special high altitude reconnaissance airplane. A broad description of the technical features and weight of the aircraft, the schedule for construction, and comments on special problems of the power plant and certain equipment items are included.

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THE AIRPLANE

The aircraft is shown by the three-view drawing on page 4.

It is a single engine, single place, high aspect ratio mid-wing monoplane, having the following characteristics:

Wing span	80 feet
Wing area	600 sq. ft.
Wing thickness - root to tip	9% to 6%
Flaps	none
Aileron area	33.8 sq. ft.
Dihedral - mean line	+ 1-1/2°
Aspect ratio	10.67
Wing loading - average	23#/sq. ft.
Tail area - horizontal	60 sq. ft.
vertical	38 sq. ft.
Tail thickness ratios	7%
Fuselage length	47.5 feet
Fuselage projected area	24.8 sq. ft.
Power plant	P & W J57 - JT3M Specification - 1654 Static thrust - S.L. 10,200 lbs. Afterburner - none

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Cockpit pressurization	25,000 ft. at 75,000 ft.
Landing gear	Single main gear plus tail wheel and outriggers
Controls	All simple, mechanical un-boosted type
Weights:	
Normal take-off	15,000 lbs.
Empty	9,550 lbs.
Overload	16,800 lbs.
Fuel capacity	972 gals.

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The aircraft is designed for transport type load factors (2.5g limit and 3.75g ultimate). Design speeds are Mach number .80 or 300 mph indicated, whichever is reached first. Large fuselage dive flaps are provided for speed control.

The landing gear consists of a pair of wheels and a shock strut which can be lowered from the fuselage just aft of the camera bay, plus a small tail wheel and jettisonable stabilizing outriggers. For landing, small wheels in a section of the wing tips deflected down 90° take the shock loads off the tips. Use of this type of landing gear saves about one-half the normal gear weight and also leaves the wing with an optimum structure and maximum fuel capacity.

Extreme weight and drag control are necessary to obtain the design range and altitude.

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THE RECONNAISSANCE EQUIPMENT

A special bay in the aircraft located behind the cockpit and ahead of the landing gear is provided for certain special reconnaissance equipment. This bay has the general dimensions shown on page 7. Various combinations of equipment worked out with Dr. James G. Baker have been designed to fit into this volume. The maximum equipment weight provided for the various aircraft missions is 450 pounds.

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POWER PLANT PROBLEMS

The success of the whole project is totally dependent on the ability of the engine to run at altitudes up to [redacted] feet and develop reasonable STAT thrust and fuel consumption. There is no data available on this subject, to my knowledge, except for basic burner development. It seems in order to choose an engine with the highest compression ratio available, if difficulty does not develop due to Reynold's Number effects on compressor blading. This latter factor has been estimated roughly and included in the performance data to follow. The engine selected is the Pratt & Whitney JT3M, rated 10,200 lbs. static thrust at sea level. Military power is drawn throughout the mission (7 to 8 hours). The thrust at [redacted] feet is estimated to be STAT 490 pounds at a speed of 431 knots, as shown on page 9. For shorter missions or higher altitudes, the use of 102% rpm, 25°C higher tailpipe temperature, and similar ratings should be considered.

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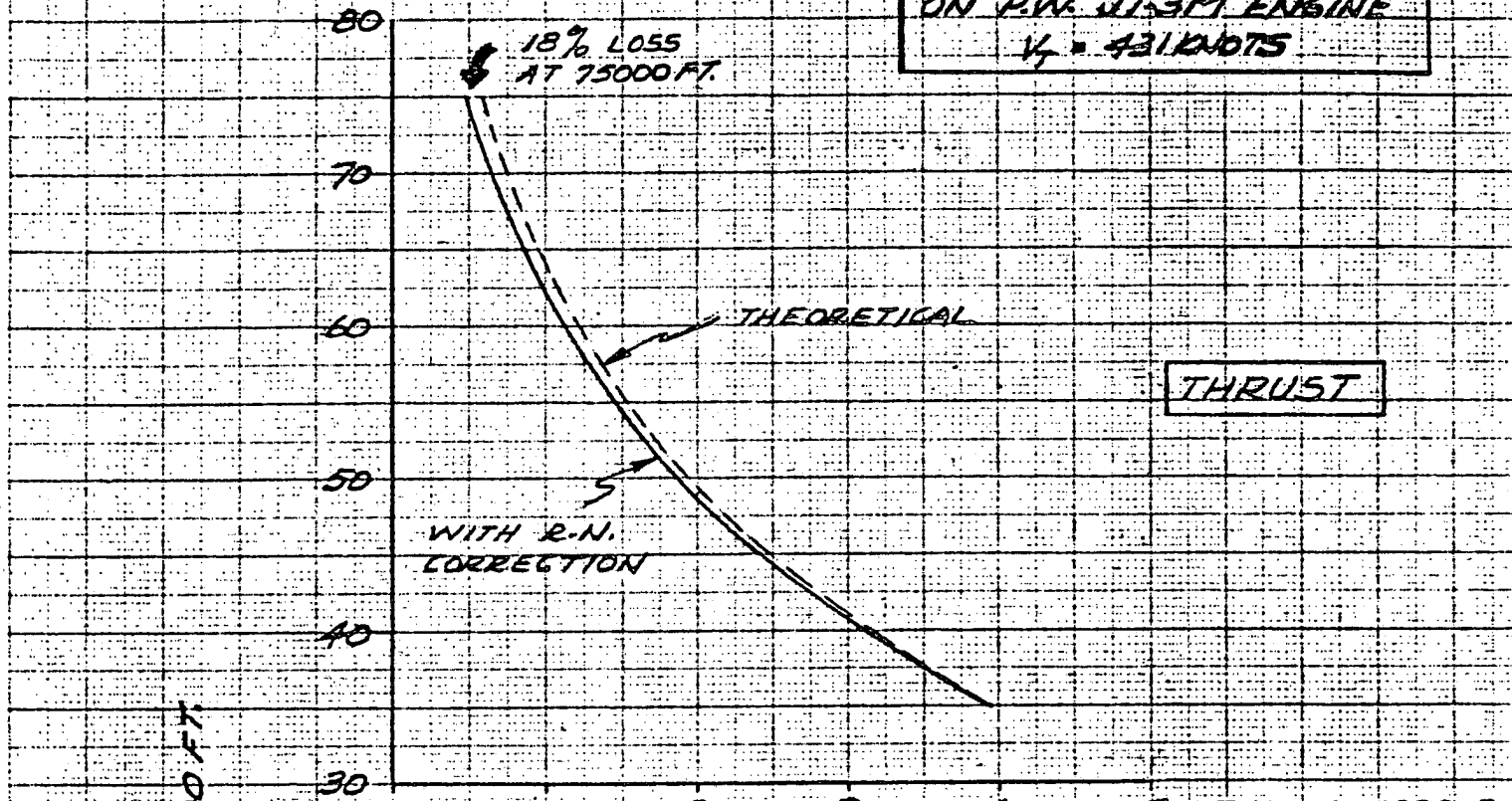
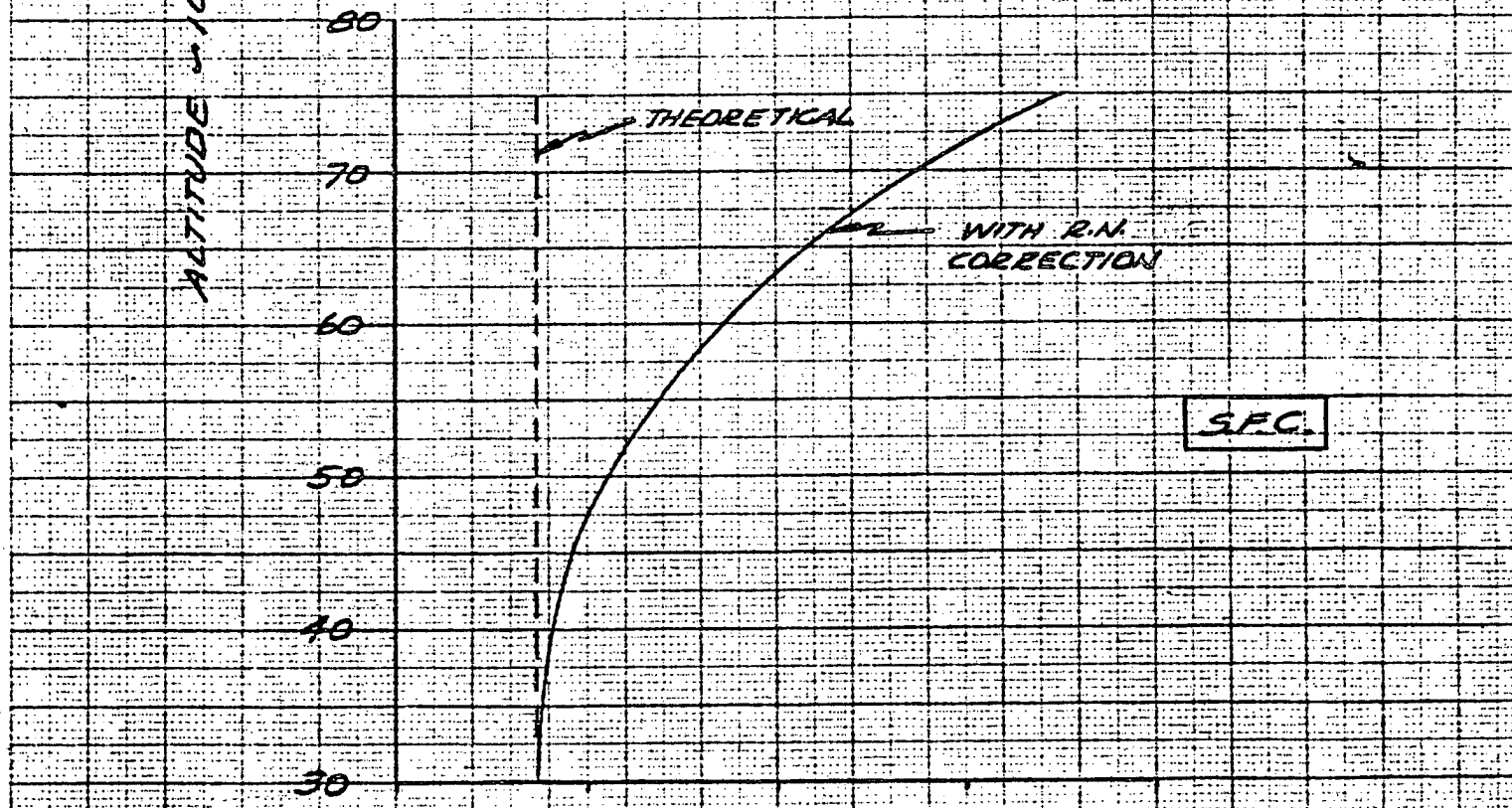
ESTIMATED EFFECT OF REYNOLDS NUMBER ON P.W. JT3D ENGINE

V_T = 431 KNOTS

THRUST



S.F.C.



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FUEL PROBLEMS

It is planned to carry all fuel in the wings (except for a small sump tank) in integral tanks. Use of fuel cells would involve a loss of about 30% in volume and would be heavier than integral tanks. A basic problem (particularly if fuel cells were to be used) is the vapor pressure of JP-4 at high altitude. The fuel vapor pressure is important for two reasons:

(1) If the fuel boils, it escapes through the vents, and range can be seriously reduced.

(2) The pressures developed by boiling fuel tend to bulge out the wing or tank structure. This is very serious when light construction is used.

Page 11 shows the pressures to be expected versus altitude for various fuel temperatures.

Normal new JP-4 of Reid Vapor - 3#/sq. in. has a basic pressure of 1.05#/sq. in. at 40°F. fuel temperature. This fuel would not boil until an altitude of 60,000 feet was reached by the aircraft. However, it is easy to get JP-4 of Reid Vapor Pressure less than 2#/sq. in. This fuel at 32°F. will not boil to altitudes of 75,000 feet. Weathered fuel of 0.2#/sq. in. is obtainable and this could provide a better margin of safety from boiling at altitude. In this case, however, the engine combustion might be adversely affected.

It appears that pre-cooled fuel of R.V.P. 2#/sq. in. at a temperature of 30° to 35° F. should be used in this aircraft.

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PERFORMANCE

A performance summary is shown on page 13. In addition, the following information is pertinent:

High speed - 35,000 feet	460 knots (M .8)
70,000 feet	460 " "
Take-off speed	90 "
Landing speed	76 "
Indicated speed in climb	150 "
Glide distance from 71,000 feet, power off	290 nautical miles

Typical normal missions are shown on pages 14, 15, 16, and 17.

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STAT
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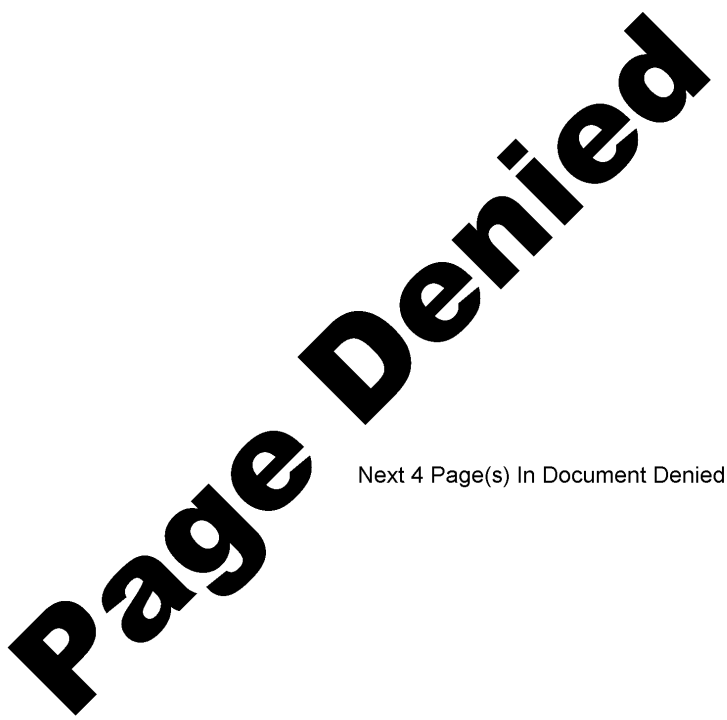

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SPECIAL MISSIONS

In certain cases, it might be desirable to tow this aircraft by a B-50 or a B-57. This is entirely feasible. Towing should be done at altitudes between 25,000 and 30,000 feet, after the reconnaissance aircraft has taken off on its own power and hooked onto the towing aircraft at 5,000 feet. The altitude chosen for towing is based on not having a running engine in the towed craft to provide cockpit pressure. Additional oxygen, a battery, and nose towing hook must be provided for towing.

It is not feasible to carry this aircraft in a B-36 and no refueling provisions are provided, for weight reasons. As long as altitude over the target is the determining consideration, refueling is not a useful means of extending range. This conclusion is subject to two over-riding factors -- certain special geographic problems and ability to get the expected engine fuel consumption.

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SCHEDULE FOR AIRCRAFT

This plan proposes construction and test of four aircraft, having them available for service by December 1, 1955. The first aircraft flies on August 2, 1955. The schedule for delivery of 16 additional aircraft, with spares, is one additional year. For actual delivery dates of individual aircraft, see page 18. A schedule of G.F.E. requirements will be provided by January 4, 1955. The first engine is needed about March 15, 1955. Special reconnaissance equipment should be available for installation here by June 1, 1955.

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DEVELOPMENT PLAN

It is proposed to build the first four airplanes and several static test components the first year. A gap then occurs, as shown on the schedule chart, before the last sixteen are built during the second year. These assumptions are made in this proposal:

(1) The go-ahead date of December 1, 1954, has already been given Lockheed verbally.

(2) The absolute minimum type drawings and systems are used to produce these aircraft.

(3) No mock-up, 689, or other similar conferences normal to other Air Force development programs are proposed.

(4) A single Air Force officer of substantial rank will be the Lockheed contact for assistance in the program. This officer will see that engine and G.F.E. requirements are met in a timely fashion and will serve as the approving agency for design decisions, as required.

(5) Lockheed accepts the complete [redacted] responsibility. STAT There may be an exception for certain reconnaissance equipment which is to be subcontracted. This phase of the program is to be resolved December 16, 1954, in an Air Force conference at Washington.

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(6) The basic arrangement of the XF-104 cockpit will be used, modified only to take the proper reconnaissance equipment. No ejection seat is provided.

(7) The Contractor is delegated the complete responsibility for determination of tests to be conducted, inspection, material and process control, and similar factors, essentially in the manner used to develop the XF-80.

(8) The aircraft will be tested at a remote base and not at Edwards Air Force Base. A special truck-trailer element will be constructed and used at the test ~~sight~~ site to provide required test facilities.

(9) Lockheed will provide spare aircraft parts, ground equipment, and fuel precoolers (if required) concurrently with the fourth aircraft, for the first four, and with each succeeding group of two aircraft.

(10) Only the barest essentials of flight and maintenance manuals are to be provided. It is assumed that this Contractor provides trained ground crews and two test pilots for servicing the aircraft through their missions, test flying the aircraft, and, finally, checking out the military pilots.

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(11) Two space mock-ups, accurately depicting the usable volume for the reconnaissance equipment, will be provided the equipment subcontractors at the earliest possible dates.

(12) A definitive contract or letter contract, of simple form, can be issued by December 23, 1954.

(13) Quick direction and assistance to the Contractor is to be provided in the problem of security and clearance of personnel -- for instance, instructions to BuAer and Air Force representatives now resident at Lockheed, who have plant cognizance in normal security matters.

(14) It is assumed that the first four aircraft will be tested in the continental United States, but that the last sixteen are to have their wings installed and be flown initially away from the U.S.A. There is, in effect, no "production flight testing."

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